A METHOD AND ARRANGEMENT FOR PROVIDING USER INFORMATION TO A
TELECOMMUNICATION CLIENT.

TECHNICAL FIELD

5   The present invention relates generally to a
method and arrangement for providing requested information
to a telecommunication client regarding a plurality of
users. In particular, the invention is concerned with making
the communication more efficient in the process of
10   delivering such information to the client.

BACKGROUND OF THE INVENTION AND PRIOR ART
        Fixed and mobile communication terminals have so
far been used mainly for making voice calls. The service of
15   communicating limited text messages, such as SMS (Short
Message Service) messages, is also used extensively by
mobile terminals. These are fairly straightforward
telecommunication services which use well-established
technologies for chiefly circuit-switched single
20   connections. In the standardized communication protocols
used for calls between fixed and/or mobile terminals,
predefined sets of communication rules and parameters are
typically used.
        A multitude of new telephony services are now
25   rapidly being developed, which can be employed in particular
by the introduction of new communication technologies which
provide greater network capacity and higher transmission
rates. For example, GPRS (General Packet Radio Service) and
WCDMA (Wideband Code Division Multiple Access) technologies
30   are currently emerging for enabling wireless telephony
services requiring a wide range of data rates and different
protocols. The trend today is a move towards packet-switched

networks and technologies providing more capacity and
flexibility. Further, new sophisticated terminals for
communication are also emerging on the market, adapted to
handle the new services.

5   Many of the new services involve real-time
transmission of video information as well as audio
information, and may further include the transmission of
added data representing text, documents, images, audio files
and video files in a multitude of different formats and

10 combinations. Such services are generally referred to as
"multimedia" services, which term will be used in this
description to represent any telephony services that involve
the transfer of information in addition to ordinary voice.
Another trend is to converge all services on to a single

15 transport mechanism – the Internet Protocol (IP), regardless
of the type of access networks and technologies.

        Recently, a network architecture called "IP
Multimedia Subsystem" (IMS) has been developed by the 3rd
Generation Partnership Project (3GPP) as an open standard,

20 to give operators of access networks the ability to offer
multimedia services in the packet domain. An IMS network,
comprising various different network elements to handle the
services, can be built above any type of access network and
is independent of the access technology used, provided that

25 the access network is able to support the service
requirements in terms of bandwidth, QoS (Quality of
Service), etc. Hence, IMS is a platform for enabling
services based on IP transport, not restricted to any
limited specific set of services.

30   Two important examples of services that can be
employed by means of the IMS solution are Instant Messaging
(IM) and Presence services. In the IMS solution, presence

services are supported by the "Session Initiation Protocol" (SIP) which has been defined by IETF as a generic session management protocol to support a wide range of IP-based services. SIP is purely a signalling protocol for creating, modifying and terminating communication sessions with one or more participants.

Instant Messaging involves the transmission of relatively short messages, e.g. including text, pictures, logos audio/video clips, etc., in "near real-time" between terminals, i.e. with small delays. In this context, "presence" is basically a dynamic and variable state profile of a user, and the presence services basically involve making the presence of a user visible to other users, which furthermore can be used to control other services in turn. This user profile comprises so-called "presence data" basically defining the state of the user and his/her equipment in any predefined respect. Thus, the term "presence" is here given a very broad meaning, and the following "user states" may for example make up the presence data:

- A personal status, such as: available, busy, in a meeting, on holiday, etc.
- A terminal status, such as: switched on/off, engaged, out of coverage, etc.
- The geographic location of the user/terminal.
- Terminal capabilities, such as: functionality for SMS, MMS, chat, IM, video, etc.
- Terminal selections, such as: call forwarding, language, etc.
- Other information, such as: interests, occupations, personal characteristics, moods, personal logos, logo depending on the current mood, etc.

All this information, or any selected parts thereof, is stored in the IMS network, based on so-called "publications of events" received from the network or a user whenever the user changes any of his/her presence data.

5   According to some services, it is possible for a user to subscribe for selected presence data of one or more other users, e.g. according to a list of users which may be either predefined, such as a phone book, or ad hoc, i.e. temporarily defined. A user subscribing for presence data

10 will hereafter be called a "client". Presence subscriptions are typically provided and handled by a functionality in the IMS of the client's access network.

A client may thus subscribe for presence data according to a list of users during a limited period of

15 time, e.g. 12 hours. In one current implementation, the subscription period may be further extended upon request at any time before expiry. This service may be provided such that during the subscription time period, the client will receive a notification from its IMS network as soon as one

20 of the users in the list has changed his/her presence data, such as having moved to another location. This is often referred to as a "push" behaviour. Alternatively, the client may subscribe for presence data by requesting presence data just once, thus allowing the client to fetch information

25 when needed by request, i.e. a "pull" behaviour. Thus, each time the client requests for presence data, a "one-off subscription" is established, meaning that the subscription is valid for only one such delivery. The mechanisms for these services has been defined by IETF (Internet

30 Engineering Task Force).

A basic procedure according to the prior art for providing presence data of a group of users to a client,

will now be described with reference to Fig. 1, which
illustrates schematically a typical communication scenario.
In this example, a client 100 is wirelessly connected to a
mobile access network 102, hereafter called "client access

5   network", and a number of other users 104 are likewise
connected to various other mobile access networks 106a-c. It
is assumed that each of the involved networks 104, 106a-c is
capable of providing the above-described presence service,
e.g. by means of having the IMS solution implemented for

10   each network. This means that each network has the necessary
network elements, not further described here, to receive and
handle presence data updates by the publication of events
from connected users whenever their presence data is
changed.

15   Moreover, the client access network 102 is also
adapted to collect updated presence data of the users 104
from the other networks 106a-c, and to provide presence
information on the users to the client 100, either by a push
behaviour or a pull behaviour as described above. In the IMS

20   solution, a network element called "Resource List Server
(RLS)" is used for providing such presence information to
the client. Of course, the other networks 106a-c are also
capable of providing presence information in the same manner
to their respective clients, i.e. any user 104, in

25   accordance with their subscriptions.
                According to a previous solution, when the client
100 makes a one-off subscription request for presence data
of a list of users 104, the client access network in turn
sends a request, or "poll", for presence data to each of the

30   networks 106a-c to which the concerned users are connected.
When the client access network has received responses, or
notifications, from all networks 106a-c regarding the

present states of the users 104 in the list, a notification
is sent to the client containing the desired information on
the users 104. This is a pure pull behaviour and can be
repeated whenever the client desires to fetch such
5   information.

However, this procedure is complicated and quite
time-consuming, since the client access network must issue
several requests and wait for notifications from all
networks 106a-c, before sending the notification to the
10   client. Moreover, the fetching of data will require
considerable amounts of inter-network signalling, especially
if many networks are involved. Upon repeated requests, some
of the networks may also provide notifications comprising
the same information with no updates, as compared to a
15   previous notification. Hence, much of the inter-network
signalling triggered by the client's request may even be
unnecessary. In addition, when many different
operators/networks are involved, standard procedures must be
followed not allowing for internal and/or local
20   optimisations.

Furthermore, in the current solution, information
on all users in the list is sent to the client in response
to his/her request, even if only some or none of the users
have made any updates since last time. Therefore, the
25   notification message sent to the client is always "full-
sized" regardless of how many users that have actually
changed their state since last time. As a result,
unnecessary bandwidth for the wireless connection with the
client 100 is occupied over a limited radio interface when
30   the notification is sent to the client.

In another prior art solution, when the client 100
has an ongoing time-limited subscription for presence data

of the users 104, the client access network has in turn
established a subscription with each of the concerned
networks 106a-c, and thereby automatically receives a
notification from any of the networks each time a user in
5   the subscription connected thereto changes his/her presence
data. Thereafter, the client access network sends a
notification to the client containing the updated presence
data, after each notification from the networks, according
to a pure push behaviour.

10   The drawbacks of this solution is that the client
may potentially receive a large amount of notifications,
which will exhaust the battery power of the client terminal,
and again, precious bandwidth is occupied for the client's
wireless connection with the client access network 102 over
15   a limited radio interface. Such problems can be partly
overcome by the client access network setting a minimum time
period between successive notifications to the same client,
a so-called "rate limitation". However, if the client really
needs information in real-time, the rate limitation value
20   must be set quite short such that the actual saving of
notifications becomes insignificant.

          In some known solutions, the client may also be
requested to set a minimum time period between successive
notifications, sometimes referred to as a "throttle time".
25   Nevertheless, the client will inevitably receive user
information also when not needed, or even without noticing,
e.g. if the terminal is inaudible. Furthermore, in the prior
solutions, the client access network must establish a
separate subscription for each user that on the client has
30   requested information for, even when several users belong to
the same access domain, resulting in many inter-network
messages for a single client subscription.

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When providing requested information to a telecommunication client regarding a plurality of users, it is desirable to generally reduce the signalling activities, particularly over the critical radio interface, without imposing unwanted delays, in the process of delivering such information to the client.

SUMMARY OF THE INVENTION

The object of the present invention is to reduce or eliminate the problems outlined above. This object and others are obtained by providing a method and arrangement for providing information to a client from a client access network in the form of user information regarding a plurality of users. According to said method, a subscription request is first received from the client for certain information on a set of users, whereupon information updates regarding users in the set are received and stored. A subsequent request for user information is later received from the client, and stored user information is then retrieved corresponding to the requested information. Finally, a notification is sent to the client regarding the retrieved user information, in response to the subsequent user information request. Typically, the users in the set are mobile users, and the user information may be presence information on the users.

If the users in the set are connected to other access networks, the client access network establishes a network subscription for user information updates with each of the other access networks to which users in the set are connected, in response to the received client subscription request.

If several of the users in the set are connected to the same user access network, the client access network may send one common subscription request for those users to that user access network, including a list of the users in the set being connected to that network.

Information updates may be continuously received from the other access networks whenever changes of state are detected for the users in the set, impacting the present network subscription.

After establishing the network subscriptions, information may be initially received from the other access networks on the current states of their respective users. An initial notification may then be sent to the client regarding the received user information, before receiving the subsequent user information request.

The subsequent request for user information received from the client may be limited to a subset of users comprising fewer users than the original set of users. The subsequent user information request may further be limited to one or only some types of information, out of the information types included in the subscription. The subset of users and/or types of information of interest in the subsequent request may be selected by the client, or may be adapted to a service and/or application currently utilised by the client.

A subsequent notification may be sent to the client indicating only the changes since the previous notification, or that nothing has changed since the last notification.

The subscription request from the client may indicate the types of information needed, as well as a time of expiration. The subscription request may further indicate

a minimum time between successive notifications
corresponding to the time of expiration.

The set of users may be selected by indicating a
predetermined list of users, or as an ad hoc list of users.
The set of users may further be selected by adding users to
or deleting users from a predetermined list of users.

The present invention further embraces an
arrangement in a client access network for providing
information to a connected client in the form of information
regarding a plurality of users. The arrangement comprises an
information delivery server adapted to receive a
subscription request from the client for information on a
set of users, and to receive information updates regarding
the set of users from their respective access networks. The
arrangement further comprises a data storage means for
storing updated user information. The information delivery
server is further adapted to receive a subsequent request
for user information from the client, and to retrieve
requested user information from the data storage means and
send a notification to the client including the retrieved
user information, in response to the user information
request.

If at least some of the users in the set are
connected to other access networks, the information delivery
server may further be adapted to establish a network
subscription for user information updates with each of the
other access networks to which users in the set are
connected, in response to the received client subscription
request.

The information delivery server may further be
adapted to continuously receive information updates from the

other access networks whenever changes of state are detected for the users in the set.

The information delivery server may further be adapted to initially receive from the other networks, information on the current states of their respective users.

The information delivery server may further be adapted to send an initial notification to the client containing the received user information.

The information delivery server may further be adapted to send to the client a subsequent notification indicating only the changes since the previous notification.

The information delivery server may further be adapted to send to the client a subsequent notification indicating that nothing has changed since the last notification.

Furthermore, the arrangement may comprise a user list server adapted to maintain various lists of users defined for clients of the client access, and to provide a predetermined list as a basis for the selected set users.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in more detail by means of preferred embodiments and with reference to the accompanying drawings, in which:

- Fig. 1 is a schematic view of a typical communication scenario for providing information on users to a client, according to the prior art.

- Fig. 2 is a schematic view of a communication scenario for providing information on users to a client, in accordance with one embodiment of the present solution.

- Fig. 3 is a flow chart illustrating a procedure for updating user information, which in known per se but can be utilised for the present solution.

- Fig. 4 is a flow chart illustrating a procedure for
5 providing user information to a client, according to one embodiment of the present solution.

DESCRIPTION OF PREFERRED EMBODIMENTS

A preferred embodiment of the present invention
10 will now be described, initially with reference to Fig. 2. Similar to the communication scenario illustrated in Fig. 1, a client 200 is connected to a client access network 202 using a terminal capable of wireless communication. In this context, the term "client access network" should be broadly
15 understood as any network capable of providing the below-described service to the client being currently connected thereto, and is not necessarily the network where the client has his/her permanent mobile subscription, i.e. the home network. The client access network 202 could also be a
20 visited network, e.g. in a foreign country.

Also, a number of other mobile users 204 are connected to various further mobile access networks 206 in other domains. In this example, three such networks 206a-c are shown, although any number of networks and users may be
25 involved in the present invention, typically many more than those illustrated here. A number of further mobile users 204, not shown, may also be connected to the client access network 202 which can be involved in the service described below, although not included here. It should be noted that
30 the present invention is not limited to mobile users, but can be used for fixed users as well, or a mix of mobile and fixed users.

Each of the networks 202, 206 is adapted to generally provide updated user information to subscribing clients as requested, e.g. according to the above-described presence service by having an IMS network connected to each

5   network. In this example, each of the networks 206a, 206b and 206c comprises a user data collecting unit 208a, 208b and 208c, respectively. Each unit 208a-c is adapted to detect changes of state for users, e.g. by receiving event publications, either from connected users 204 or by

10   receiving information from the associated network itself, whenever a user changes his/her state, e.g. the presence data as exemplified above, in some predefined manner. The user data collecting units 208a-c are thus adapted to keep track on the states of the users 204, based on the received

15   information. A corresponding user data collecting unit may of course be arranged in the client network 202 to collect user information from its connected users, although not specifically indicated in the figure.

        For example, a network 206 may have a functionality

20   of detecting the geographic position of a user, e.g. by means of GPS (Global Positioning System), or signal strength and/or signal delay measurements, which is stored in the associated user data collecting unit 208. Whenever the network detects a change in the user's position, the user

25   data collecting unit will update the current position data for the user. In another example, a user may input a current personal mood in his/her terminal, such as "sad" or "happy", which is sent to the network and its user data collecting unit for update, and so forth.

30   The client access network 202 comprises an information delivery server 210 for providing information to the client 200 regarding a plurality of users, as desired by

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the client, by sending notifications to the client, to be described below. Of course, a corresponding information delivery server may be arranged in each of the networks 206, although not shown here. For example, the information delivery server may be integrated with a user data collecting unit in a single server or entity. In practice, the server 210 may be a Resource List Server (RLS) if an IMS network is implemented in the client access network 202, although the general term "information delivery server" will be used in this description to represent any possible network entity having the function described below. The user information in question may of course include any of the above-described types of presence data or similar, but is not limited thereto.

The server 210 is connected to a user list server 212, which in the IMS example is an entity called "Group List Management Server, GLMS". The user list server 212 is adapted to maintain various lists of users defined for clients of the client access network 202, such as phone books, contact groups or the like. The lists may further be divided into various sublists, e.g. depending on specific subjects and interests. The sublists may further be valid for specific services and/or applications. The user list server 212 is also connected to a user data storage means 214, hereafter called user database, for storing updated user information according to the lists, to be described below. The user database 214 may be implemented as a cache memory or the like. In practice, the above-described functional units 210, 212 and 214 may be incorporated into one common server unit.

Briefly described, the present solution allows the client to initially subscribe for selected state information

on a set of users as defined by a user list, either
predefined or ad hoc, during a limited and specified period
of time. In response to such a subscription request from the
client, the information delivery server 210 then establishes

5   a subscription for user information with each network 206a-c
to which the users in the set are connected. The associated
user data collecting units 208a-c will then send updated
user information to the information delivery server 210,
whenever a user change his/her state or presence data in a

10   way that impacts the user information of interest as
selected by the client for the subscription.

In the present solution, however, the information
delivery server 210 does not automatically send
notifications to the client as soon as changes occur. In

15   contrast to the previously used push behaviour, the updates
received from the other networks are stored in the user
database 214 for later retrieval, instead of being pushed to
the client. Thus, received updated information is
continuously collected in the user database 214 for the

20   duration of the subscription.

When the client 200 really wants user information,
he/she can send a subsequent data request to the information
delivery server 210. In response to such a data request,
relevant and updated data is retrieved from the user

25   database according to the list as maintained in the user
list server 212, and the data is then duly sent to the
client 200. In this way, notifications will only be sent to
the client when really needed and asked for, and the
relevant information has already been collected in the

30   database 214, ready to be promptly sent to the client upon
request. Hence, the present solution is a combination of a
push behaviour of the networks 206 to the client access

network 202, and a pull behaviour of the client 200 from the client access network 202.

Fig. 3 illustrates a flow chart of a procedure for updating user information during a subscription. As
5   mentioned above, the information delivery server 210 establishes a network subscription with each network 206a-c to which the users in the set are connected, in response to receiving an initial subscription request from a client 200. The subscription request from the client may contain a
10 specification of the particular users on which the client is interested to receive information, and also of what type of information the client wants to receive. The client may also indicate the duration of the subscription, e.g. specified as an expiry time. Alternatively, the subscription may be set
15 to run for the time being, i.e. until the client indicates that is to be terminated, or may be limited by a default duration length if the client has not indicated a duration.

The client may indicate the set of users of interest by giving a mere reference to a predetermined list
20 which is already known in the user list server 212. Alternatively, the users may be individually specified in an ad hoc list given by the client, or users may be added to and/or deleted from a predetermined list.

The flow chart in Fig. 3 illustrates the procedure
25 executed in a user data collecting unit 208 associated with one of the networks 206 to which one or more users in the set is/are connected. The client access network 202 first sends a network subscription request for information on one or more specific users belonging to the network 208 in
30 question, in accordance with the client's request. Thus in a first step 300, a subscription request is received from the client access network 202 with the same expiry time as that

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specified by the client. From now on, the user data collecting unit 208 will send notifications to the client access network regarding the concerned user(s) whenever changes occur impacting the requested user information.

Next in a step 302, a change of state is detected for a user in the set, e.g. in a manner as described above, indicating that this particular user has changed his/her state, e.g. presence data, in some way that is relevant to the subscription. A notification is then sent from that user's access network to the client access network, containing updated user information indicating the detected change of the user, in a next step 304.

In this example, a step 306 is illustrated where it is determined whether the subscription with the client access network has expired. If not, steps 302 and 304 may be repeated whenever a user changes his/her state or presence data as relevant to the subscription. When the network subscription has finally expired, it is terminated in a step 308 and no more updates are sent to the client access network. Of course, an active step 306 of checking the expiration may not be necessary, as the subscription can be automatically terminated as soon the time has expired, or when the client indicates termination.

It should be noted that the updating procedure described in Fig. 3 is basically the same as previously used for a pure push behaviour, and is therefore not affected by the present solution. The inventive procedure of providing information to a client, as described below with reference to a preferred embodiment illustrated in Fig. 4, however utilises a pull mechanism between the client and the client access network. The following procedure is generally executed in the client access network 202, the active steps

being mostly taken by the information delivery server 210.
illustrated in Fig. 2.

In a first step 400, the client access network 202
receives a subscription request from the client 200

5   indicating a set of users 204, as described above, such that
the client access network can identify the users, the wanted
type(s) of user information and the duration of the client's
requested subscription, e.g. by means of predetermined lists
maintained by the user list server 212. The subscription

10   duration may be determined in different ways, as exemplified
in connection with Fig. 3.

From this information, the client access network
can send corresponding subscription requests to the
concerned networks 206 to which the users 204 are connected,

15   and a network subscription is established accordingly with
each network 206a-c, in a step 402, for information on users
in the set connected to the networks, respectively. The
network subscriptions may also be limited to specific types
of information, as requested by the client, such as position

20   only, or position and mood, etc. It should be noted that the
user set of interest may well include users that are
connected to the client access network as well.

In one embodiment, in the case when several of the
users in the set are connected to the same network 206, the

25   client access network preferably sends one common
subscription request for information on those users to that
network 206, including a list of the users in the set being
connected to that network. This will result in a reduced
amount of signalling as compared to sending a separate

30   subscription request for each user to the same network 206.
Hence, only one subscription request is preferably sent per
domain in order to minimise the inter-network signalling.

Another benefit is that any throttling or rate-limiting
functions for the subscription can be controlled per domain,
instead of per user.

     Once a subscription has been established with each
network 206, the networks will initially send information on
the current states of their respective users 204, which is
received in a step 404. Next, the client access network 202
may send an initial notification to the client 200
containing the current states of the users of interest,
according to the received information, in a step 406,
assuming that the client is interested in the information
immediately after having sent the subscription request. In
this concept, and in the following, the term "notification"
is intended to cover any type and/or combination of
message(s) and/or indication(s) that can be utilised to
convey this kind of information to the client.

     In an alternative embodiment, step 406 may however
be omitted in order to avoid any unneeded notification not
requested by the client. So far, a push behaviour has been
used but from now on, after the initial data has been sent
to the client, the client access network will not send any
data unless the client asks for it, hence a pull behaviour.

     According to the ongoing network subscriptions, the
client access network receives from the networks 206 various
updates on the user information relevant to the
subscription, whenever the users change their states, as
described in connection with Fig. 3, which is generally
indicated in a next step 408. Each time such updated
information is received, the client access network stores it
in the user database 214, as indicated in a step 410. If
users connected to the client access network are also

included in the list, relevant updates on them can of course be handled internally by the client access network.

Next, a step 412 is illustrated for checking whether the client's subscription has expired or not, and if

5   it has, the client subscription, as well as the associated network subscriptions having the same expiration time, are terminated in a step 414. However in practice, it is not necessary to perform this as a specific step at this point in the procedure, but this can of course be checked or

10 watched more or less continuously throughout the procedure.

Next in the procedure, the client has decided to fetch updated information, and a subsequent information request is received from the client in a step 416. Typically, a certain amount of time has elapsed since the

15 user information was initially sent in step 406, and some of the user information may have changed during this period.

In one embodiment, the subsequent information request received from the client may be limited to a subset of users comprising fewer users than the original set of

20 users in the client's subscription. Furthermore, the subsequent information request may be limited to only one or some of the different types of information included in the subscription. For example, the requested subset of users and/or information type(s) may be adapted to a service

25 and/or application currently utilised by the client. In this way, the client is free to request updated information for any selected users in the original set, or for any selected type(s) of user information of the subscription, depending on his/her current needs.

30   In response to the client's information request, the current updated version of the requested user information is retrieved from the user database 214, in a

next step 418, which is then duly sent to the client in a notification, in a step 420. Retrieving relevant data from the user database in this way is a much faster procedure as compared to requesting and receiving the information from

5   all of the concerned networks 206.

The process may then move back to step 408 for receiving further updates from the networks 206, as in step 408, as well as any further subsequent information requests made by the client, as in step 416. In order to make the

10   notifications to the client shorter and more efficient, a short indication of only the information changes since the last notification is preferably sent in the notification step 420, instead of the complete set of data. If nothing has changed since the last notification, a very short

15   indication thereof may be sent. In this way, the size of the notification message(s) sent to the client may be less than full-sized and can be kept at a minimum, resulting in optimal use of precious bandwidth in the wireless interface.

By the combined push and pull mechanisms according

20   to the present invention, a most efficient solution is obtained where a minimum of data amounts need to be transmitted between the client access network 202 and the other access networks 206, as well as between the client access network 202 and the client 200. In particular, the

25   client access network does not have to fetch information from every network when information is requested by the client, but this information has already been received and stored continuously by means of the ongoing network subscriptions and is therefore immediately available from

30   the user database.

Wanted information can also be conveyed to the client with a minimum of delays, i.e. the need for real-time

information can be satisfied to a great extent. Moreover, this solution offers great flexibility for the client, since user information may be requested for any of the users in the originally subscribed set of users, depending on the

5   client's current needs or on which service and/or application is utilised at the moment.

The above-described service can be accomplished by using existing messages and protocols, e.g. as currently being defined by the IETF specification RFC3265. In order

10   not to receive unwanted notifications from the client access network, the client can then indicate a throttle time equal to the expiration time, such that no notifications will be issued, or pushed, automatically during the entire subscription, other than when occasionally requested, or

15   pulled, by the client.

The present invention may be used in conjunction with existing services available from the IMS network, such as "Push-to-Talk over Cellular" (PoC), Instant Messaging and of course the above-described Presence service, etc.

20   While the invention has been described with reference to specific exemplary embodiments, the description is only intended to illustrate the inventive concept and should not be taken as limiting the scope of the invention, which is defined by the appended claims.

25